IN THE DRAWINGS

Please replace page 7/8 of the drawings including Figures 13, 14 and 15 with the attached amended drawing sheet including Figures 13, 14 and 15.

REMARKS/ARGUMENTS

Claims 10-23 remain pending in this application with claims 10-12, 16, 20-23 being amended and claims 1-9 being cancelled. Support for these amendments to the claims can be found throughout the specification, and specifically on page 2, lines 1-7 & 16-20. Therefore, applicants respectfully submit that no new matter is added by the amended claims.

Objection to the Specification

The specification is objected to for certain informalities. The specification was amended in a Preliminary Amendment, dated April 1, 2005, to add headings in accordance with the comments of the Office Action. In view of the Preliminary Amendment, it is respectfully submitted that the objection to the specification is satisfied and should be withdrawn.

Objection to the Drawings

Figure 15 of the drawings is objected to because reference character "32" is used to designate both feed line and discs. Page 7/8 of the drawings has been replaced with the attached drawing sheet amending Figure 15 to correct a typographical error by amending the reference character of the discs to "34". In view of the amendment to Figure 15, it is respectfully submitted that the objection to the drawings is satisfied and should be withdrawn.

Objection to Claim 1

Claim 1 is objected to for certain informalities. Claim 1 has been cancelled. Thus, it is respectfully submitted that rejection of this claim is now moot and should be withdrawn.

Rejection of Claim 7 under 35 U.S.C. 112, Second Paragraph

Claim 7 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 7 has been cancelled. Thus, it is respectfully submitted that rejection of this claim is no longer applicable.

Rejection of Claims 1, 5, 6, 10, 11, 14, 15, 20, 22, and 23 under 35 U.S.C. 102(b)

Claims 1, 5, 6, 10, 11, 14, 15, 20, 22, and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Itoh et al. (U.S. Patent No. 6,518,930).

Claims 1, 5, and 6 have been cancelled. Thus, it is respectfully submitted that rejection of these claims is now moot and should be withdrawn.

Claim 10 of the present claimed invention describes a microwave antenna consisting of a closed slot produced on a first metallized face of a substrate, the slot being fed via a feed line and operating at a given frequency, including a filtering structure (PBG) consisting of metal elements produced on a second face of the substrate opposite the first face, the elements facing the slot being periodically spaced and having identical surface to form a photonic bandgap structure and determining a bandgap frequency.

The present claimed invention provides an antenna or microwave device provided with a filtering structure realized on the face of the substrate opposite the face receiving the slot or slot antenna. The filtering structure is formed of metallic elements (such as discs) dimensioned and spaced to realize a photonic band gap (PBG) structure. The metallic elements are positioned in the specific area just under the slot as shown in the figures. The present invention relates to microwave antennas in which the PBG structure is formed in order to filter out certain undesirable frequencies or to obtain several communication bands by opening forbidden bands in the frequency response of a very broadband antenna. This type of antenna is particularly useful in the field of wireless telecommunications (specification, page 2, lines 25-30).

Itoh et al. describe a low-profile cavity-backed slot antenna including a cavity substrate having a slot with a resonant frequency and a uniplanar compact photonic band-gap (UC-PBG) substrate, proximate to the cavity substrate and having a two-dimensional periodic metallic

pattern on a dielectric slab and a ground plane, wherein the UC-PBG substrate behaves substantially as an open boundary at the resonant frequency of the slot.

Claim 10 of the present claimed invention features "a closed slot produced on a first metallized face of a substrate" including a filtering structure on the opposite face of the **same** substrate. All of the elements of claim 10 are combined on a single substrate. Unlike the present claimed invention, Itoh et al. describe a cavity substrate combined with a separate PBG substrate proximate to the cavity substrate, and both substrates are separated by a dielectric sheet (Itoh et al., col 2, lines 45-52). Further, in Itoh et al., the periodic pattern 116 is produced on the entire surface of substrate 102 (*See* Itoh et al., fig. 3A). This is unlike the present claimed invention, in which the periodic pattern is produced only in proximity to the closed slot (*See* figs. 2A-2D). Additionally, in Itoh et al., the PBG substrate formed by the periodic structure "behaves substantially as an open boundary at the resonant frequency of the slot." To the contrary, in the present claimed invention, a periodic pattern of elements forms a PBG structure, with the spacing and surface of the elements "determining a bandgap frequency." Therefore, Itoh et al. neither disclose nor suggest "a closed slot produced on a first metallized face of a substrate...including a filtering structure consisting of metal elements produced on a second face of **the substrate** opposite the first face, said elements **facing the slot** being periodically spaced and having identical surface...and **determining a bandgap frequency**," as recited in claim 10 of the present invention. Thus, in view of the above remarks and amendments to claim 10, it is respectfully submitted that this rejection regarding claim 10 is satisfied and should be withdrawn.

Claim 11 is dependent on claim 10 and therefore is allowable for the same reasons as claim 10. Additionally, claim 11 includes a further feature that "the periodicity of the elements of the PBG structure is chosen so that the bandgap frequency is equal to **one of the harmonics of the operating frequency** of the closed slot." Unlike the present invention as claimed in claim 11, in Itoh et al. the PBG substrate described behaves "as an open boundary **at the resonance frequency**" (Itoh et al., col 2, lines 52-55). Therefore, Itoh et al. neither disclose nor suggest "the periodicity of the elements of the PBG structure is chosen so that the bandgap frequency is equal to **one of the harmonics of the operating frequency** of the closed slot," as recited in

claim 11 of the present claimed invention. Thus, in view of the above remarks, it is respectfully submitted that the rejection of claim 11 is satisfied and should be withdrawn.

Claim 14 is dependent on claim 10 and therefore is allowable for the same reasons as claim 10.

Claim 15 is dependent on claim 14 and therefore is allowable for the same reasons as claims 10 and 14. Additionally, claim 15 includes a further feature that "**an additional photonic bandgap structure** is produced beneath the feed line in microstrip technology by demetallizing the face of the substrate opposite that receiving the feed line." This additional structure has the effect of eliminating even harmonics created by the elimination of odd harmonics (*See* specification page. 11, lines 12-21). Itoh et al. do not suggest or describe the use of an additional photonic bandgap structure as claimed in claim 15. Thus, in view of the above remarks, it is respectfully submitted that the rejection of claim 15 is satisfied and should be withdrawn.

Claim 20 of the present claimed invention describes a filtering structure on a microwave device formed by a slot produced on a first metallized face of a substrate, said structure comprising metal elements on a second face of the substrate opposite the first face receiving the slot, the elements facing the slot being periodically spaced and having identical surface to form a photonic bandgap structure and determining a bandgap frequency. All of the elements of claim 20 are combined on a single substrate. Unlike the present invention as claimed in claim 20, Itoh et al. describe a cavity substrate combined with a separate PBG substrate proximate to the cavity substrate, and both substrates are separated by a dielectric sheet (Itoh et al., col 2, lines 45-52). Further, in Itoh et al., the periodic pattern 116 is produced on the entire surface of substrate 102 (*See* Itoh et al., fig. 3A). This is unlike the present claimed invention, in which the periodic pattern is produced only in proximity a slot (*See* figs. 2A-2D). Additionally, in Itoh et al., the PBG substrate formed by the periodic structure "behaves substantially as an open boundary at the resonant frequency of the slot" (Itoh et al., col 2, lines 52-55). To the contrary, in the present claimed invention, a periodic pattern of elements forms a PBG structure, with the spacing and surface of said elements "determining a bandgap frequency." Therefore, Itoh et al. neither disclose nor suggest "a filtering structure on a microwave device formed by a slot produced on a

first metallized face of a substrate, said structure comprising metal elements on a second face of **the substrate** opposite the first face receiving the slot, said elements **facing the slot** being periodically spaced and having identical surface to form a photonic bandgap structure and **determining a bandgap frequency**," as recited in claim 20 of the present invention. Thus, in view of the above remarks and amendments to claim 20, it is respectfully submitted that this rejection regarding claim 20 is satisfied and should be withdrawn.

Claim 22 is dependent on claim 20 and therefore is allowable for the same reasons as claim 20. Additionally, claim 22 includes a further feature that "the bandgap frequency has a width and a depth depending on the equivalent area of the periodic elements." Itoh et al. describe a PBG substrate formed by a periodic structure that "behaves substantially as an open boundary at the resonant frequency of the slot" (Itoh et al., col 2, lines 52-55). Itoh et al. do not suggest or describe the dependence of the width and depth of the bandgap frequency on the equivalent area of the periodic elements as claimed in claim 22. Thus, in view of the above remarks, it is respectfully submitted that the rejection of claim 22 is satisfied and should be withdrawn.

Claim 23 is dependent on claim 20 and therefore is allowable for the same reasons as claim 20. Additionally, claim 23 includes a further feature that "the elements formed are from discs, squares, rings, or H shaped elements." Itoh et al. describe **only** a "unique two-dimensional periodic structure that comprises square pads separated by conductive gaps, and inductive lines connecting adjacent cells" (Itoh et al., col. 3, line 67; col 4., lines 1-3). Itoh et al. do not suggest or describe the use of "discs, squares, rings, **or** H shaped elements" as recited in claim 23 of the present claimed invention. Thus, in view of the above remarks, it is respectfully submitted that the rejection of claim 23 is satisfied and should be withdrawn.

In view of the above remarks and amendments to the claims it is respectfully submitted that claims 10, 11, 15, 20, 22, and 23 are not anticipated by Itoh et al. Furthermore, it is respectfully submitted that as claim 14 is dependent on independent claim 10 this claim is patentable for the same reasons as claim 10. Additionally, since claims 1, 5 and 6 have been

cancelled, it is respectfully submitted that the rejection of these claims is now moot. It is thus further respectfully submitted that this rejection is satisfied and should be withdrawn.

Rejection of Claims 4, 7, 12, 13, and 21 under 35 U.S.C. 103(a)

Claims 4, 7, 12, 13, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Itoh et al.

Claims 4 and 7 have been cancelled, thus it is respectfully submitted that the rejection of these claims is now moot and should be withdrawn.

Claim 12 is dependent on independent claim 10 and therefore includes all the features of claim 10. As discussed above regarding claim 10, claim 10 of the present invention features "a closed slot produced on a first metallized face of a substrate" including a filtering structure on the opposite face of the **same** substrate. All of the elements are combined on a single substrate. Unlike the present claimed invention, Itoh et al. describe a cavity substrate combined with a separate PBG substrate proximate to the cavity substrate, and both substrates are separated by a dielectric sheet (Itoh et al., col 2, lines 45-52). Further, in Itoh et al., the periodic pattern 116 is produced on the entire surface of substrate 102 (*See* Itoh et al., fig. 3A). This is unlike the present claimed invention, in which the periodic pattern is produced only in proximity to the closed slot (*See* figs. 2A-2D). Additionally, in Itoh et al., the PBG substrate formed by the periodic structure "behaves substantially as an open boundary at the resonant frequency of the slot." To the contrary, in the present claimed invention, a periodic pattern of elements forms a PBG structure, with the spacing and surface of said elements "determining a bandgap frequency." Therefore, Itoh et al. neither disclose nor suggest "a closed slot produced on a first metallized face of a substrate...including a filtering structure consisting of metal elements produced on a second face of **the substrate** opposite the first face, said elements **facing the slot** being periodically spaced and having identical surface...and **determining a bandgap frequency**," as recited in claim 10 of the present invention. Further, claim 12 includes the feature that "the periodicity of the elements of the PBG structure is chosen so that the bandgap frequency is greater than the operating frequency of the closed slot." Itoh et al. describe **only** a "unique two-dimensional periodic structure that comprises square pads separated by conductive

gaps, and inductive lines connecting adjacent cells" (Itoh et al., col. 3, line 67; col 4., lines 1-3), where the PBG substrate formed by the periodic structure "behaves substantially as an open boundary at the resonant frequency of the slot" (Itoh et al., col 2, lines 52-55). Itoh et al. do not suggest or describe a periodity of elements chosen so that the bandgap frequency is greater than the operating frequency of the closed slot as claimed in claim 12. Thus, in view of the above remarks, it is respectfully submitted that the rejection of claim 12 is satisfied and should be withdrawn.

Claim 13 is also dependent on independent claim 10 and therefore is allowable for the same reasons as claim 10, as previously discussed. Further, claim 13 includes the feature that "the closed slot is an annular slot." Applicant respectfully disagrees with the Examiner's assertion that the annular slot "represents an obvious expedient" in light of Itoh et al. (Office Action, paragraph 8). Itoh et al. neither describe nor suggest an annular antenna as in the present claimed invention. Unlike the present claimed invention, Itoh et al. are concerned with a cavity-backed slot antenna. Thus, in view of the above remarks, it is respectfully submitted that the rejection of claim 13 is satisfied and should be withdrawn.

Claim 21 is dependent on independent claim 20 and therefore includes all features of claim 20. As discussed above regarding claim 20, claim 20 of the present invention describes a filtering structure on a microwave device formed by a slot produced on a first metallized face of a substrate, said structure comprising metal elements on a second face of the substrate opposite the first face receiving the slot, said elements facing the slot being periodically spaced and having identical surface to form a photonic bandgap structure and determining a bandgap frequency. All of the elements of claim 20 are combined on a single substrate. Unlike the present claimed invention, Itoh et al. describe a cavity substrate combined with a separate PBG substrate proximate to the cavity substrate, and both substrates are separated by a dielectric sheet (Itoh et al., col 2, lines 45-52). Further, in Itoh et al., the periodic pattern 116 is produced on the entire surface of substrate 102 (*See* Itoh et al., fig. 3A). This is unlike the present claimed invention, in which the periodic pattern is produced only in proximity a slot (*See* figs. 2A-2D). Additionally, in Itoh et al., the PBG substrate formed by the periodic structure "behaves substantially as an open boundary at the resonant frequency of the slot" (Itoh et al., col 2, lines

52-55). To the contrary, in the present claimed invention, a periodic pattern of elements forms a PBG structure, with the spacing and surface of said elements "determining a bandgap frequency." Therefore, Itoh et al. neither disclose nor suggest "a filtering structure on a microwave device formed by a slot produced on a first metallized face of a substrate, said structure comprising metal elements on a second face of **the substrate** opposite the first face receiving the slot, said elements **facing the slot** being periodically spaced and having identical surface to form a photonic bandgap structure and **determining a bandgap frequency**," as recited in claim 20 of the present invention. Further, claim 21 includes the feature that "the periodicity between two elements is equal to $k\lambda g/2$ where λg is the wavelength of the wave guided in the slot at the chosen bandgap frequency and k is an integer." Itoh et al. describe **only** a "unique two-dimensional periodic structure that comprises square pads separated by conductive gaps, and inductive lines connecting adjacent cells" (Itoh et al., col. 3, line 67; col. 4, lines 1-3). Itoh et al. do not describe the periodicity between elements as a function of the wavelength of the wave guided in the slot at the chosen bandgap frequency as claimed in claim 21. Thus, in view of the above remarks it is respectfully submitted that the rejection of claim 21 is satisfied and should be withdrawn.

In view of the above remarks and amendments to the claims, it is respectfully submitted that claims 12, 13, and 21 are not made unpatentable by Itoh et al. Additionally, since claims 4 and 7 have been cancelled, it is respectfully submitted that the rejection of these claims is now moot. It is further respectfully submitted that this rejection is satisfied and should be withdrawn.

Rejection of Claims 16-19 under 35 U.S.C. 103(a)

Claims 16-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Itoh et al. in view of Schnetzer (US Patent 5,519,408).

Applicant respectfully disagrees with the Examiner's comment that Itoh et al. "disclose all aspects of the claimed invention except it does not teach a Vivaldi slot" (page 5). Claim 16 of the present claimed invention features "a tapered slot including a filtering structure (PBG) consisting of metal elements produced on a second face of the substrate opposite the first face, said elements facing the slot being periodically spaced and having identical surface to form a

photonic bandgap structure determining a bandgap frequency." All of the elements of claim 16 are combined on a single substrate. Unlike the present claimed invention, Itoh et al. describe a cavity substrate combined with a separate PBG substrate proximate to the cavity substrate, and both substrates are separated by a dielectric sheet (Itoh et al., col 2, lines 45-52). Further, in Itoh et al., the periodic pattern 116 is produced on the entire surface of substrate 102 (*See* Itoh et al., fig. 3A). This is unlike the present claimed invention, in which the periodic pattern is produced only in proximity to a tapered slot (*See* fig. 15). Additionally, in Itoh et al., the PBG substrate formed by the periodic structure "behaves substantially as an open boundary at the resonant frequency of the slot." To the contrary, in the present claimed invention, a periodic pattern of elements forms a PBG structure, with the spacing and surface of said elements "determining a bandgap frequency." Therefore, Itoh et al. neither disclose nor suggest "a tapered slot including a filtering structure (PBG) consisting of metal elements produced on a second face of **the substrate** opposite the first face, said elements **facing the slot** being periodically spaced and having identical surface to form a photonic bandgap structure **determining a bandgap frequency**," as recited in claim 16 of the present invention.

Schnetzer provides a radiating tapered notch antenna (Vivaldi antenna), which is fed by a section of slotline, which is in turn fed by a coplanar waveguide (Schnetzer, col. 1, lines 42-45). This is unlike the present claimed invention, which includes a filtering structure produced opposite a tapered slot. Therefore, Schnetzer, similar to Itoh et al, neither discloses nor suggests "a filtering structure (PBG) consisting of metal elements produced on a second face of the substrate opposite the first face, said elements facing the slot being periodically spaced and having identical surface to form a photonic bandgap structure determining a bandgap frequency," as claimed in claim 16.

Additionally, contrary to the assertions in the Office Action (paragraph 9), the combination of Itoh et al. and Schnetzer, similar to the individual systems, would not produce the present invention as claimed in claim 16. A combination of Itoh et al. and Schnetzer would describe a Vivaldi antenna substrate combined with a separate PBG substrate proximate to the cavity substrate, and both substrates are separated by a dielectric sheet (Itoh et al., col 2, lines 45-52). This is wholly unlike the present claimed invention, where the all of the elements are

contained on a single substrate. Further, a periodic pattern would be produced by the combination on the entire surface of the separate PBG substrate (*See* Itoh et al., fig. 3A). This is unlike the present claimed invention, in which the periodic pattern is produced only in proximity to a tapered slot (*See* fig. 15) and not on the entire surface of a substrate. Additionally, the PBG substrate formed by the periodic structure in the combination would behave "substantially as an open boundary at the resonant frequency of the slot." To the contrary, in the present claimed invention, a periodic pattern of elements forms a PBG structure, with the spacing and surface of said elements "determining a bandgap frequency." Therefore, neither Itoh et al. nor Schnetzer, alone or in combination, disclose or suggest "a tapered slot including a filtering structure (PBG) consisting of metal elements produced on a second face of **the substrate** opposite the first face, said elements **facing the slot** being periodically spaced and having identical surface to form a photonic bandgap structure **determining a bandgap frequency**," as recited in claim 16. Thus, in view of the above remarks, it is respectfully submitted that the rejection of claim 16 is satisfied and should be withdrawn.

Claims 17 and 18 are dependent on claim 16, and therefore it is respectfully submitted that claims 17 and 18 are allowable for the same reasons as claim 16.

Claim 19 is dependent on claim 16 and therefore is allowable for the same reasons as claim 16. Additionally, claim 19 describes that "**an additional photonic bandgap structure** is produced beneath the feed line in microstrip technology by demetallizing the face of the substrate opposite that receiving the line." This additional structure has the effect of eliminating even harmonics created by the elimination of odd harmonics (*See* specification page. 11, lines 12-21). Neither Itoh et al. nor Schnetzer suggest or describe the use of an additional photonic bandgap structure as claimed in claim 19. Therefore, in view of the above remarks, it is respectfully submitted that the rejection of claim 19 is satisfied and should be withdrawn.

In view of the above remarks and amendments to the claims it is respectfully submitted that claims 16 and 19 are not made unpatentable by Itoh et al. and Schnetzer, when taken alone or in combination. Furthermore, it is respectfully submitted that claims 17 and 18 are dependent

on independent claim 16 and are patentable for the same reasons as claim 16. It is thus further respectfully submitted that this rejection is satisfied and should be withdrawn.

Having fully addressed the Examiner's rejections, it is believed that, in view of the preceding amendments and remarks, this application stands in condition for allowance. Accordingly then, reconsideration and allowance are respectfully solicited. If, however, the Examiner is of the opinion that such action cannot be taken, the Examiner is invited to contact the applicant's attorney at the phone number below, so that a mutually convenient date and time for a telephonic interview may be scheduled.

No fee is believed due. However, if a fee is due, please charge the additional fee to Deposit Account 07-0832.

Respectfully submitted,
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